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Eng 338.42

REPORT

TO THE

DSON RIVER RAILROAD

COMMITTEE.

R. P. MORGAN, ESQ.
CIVIL ENGINEER.

AUGUST, 1842.

POUGHKEEPSIE:
EGBERT B. KILLEY, PRINTER.
1842.

cing it from its southern termination, it is deserving of notice, that the river shore above New-York island can be conveniently reached from almost any of the avenues. The Harlaem Railroad may be extended on the west bank of the Harlaem river, meeting our line a short distance above the high bridge; or should the period ever arrive when the increasing population of the Island may render it expedient, other branches may be extended from the city to unite with it. A line has also been surveyed by the Harlaem Company from the termination of their road to a point on the river nearly opposite Piermont. The question, however, as to which is preferable, although in itself highly important, is at present foreign to the great object of this survey, as it was designed simply to demonstrate that natural advantages exist for the construction of a Railroad along the valley of the Hudson, which are of immense importance to the city of New-York, as well as to the whole community. I would also observe, that having constantly in view the large traffic, which, at some future day, is sure to exist on a Railroad from New-York to Albany, my survey and estimates have been predicated accordingly. The calculations are for a double track, with excavations and embankments suitable for a work of the first magnitude; and wherever the road bed is on the river shore, it is to be raised four feet above extreme high water mark, and to be faced with a strong protection wall or loose rock thrown in with a natural slope. The line from Harlaem creek follows the river shore, with a few exceptions, all the way to Fishkill Landing. On the first twenty miles, there is a beautiful beach, offering the greatest facilities for construction, loose rock lying all along shore well adapted for the use required, whilst the gravelly bank above them can be wheeled in to form the road, at a very trifling expense.

It will be seen by an examination of the profile, that at Yonkers and Tarrytown, there are projecting points, which must be cut through; but they are composed of materials easily excavated. The small bays which it is deemed necessary to cross, have been carefully sounded, and are found to be very shallow, on an average, not exceeding seven feet in depth.

The shore near Sing Sing is rather more difficult, as half a mile south of the State Prison is a rocky promontory, forming a bay below it of considerable extent; but the estimate for this section allows of sufficient excavation in the rock to form a facing to the embankment across the bay, and includes the excavation in the rear of the State prison, which together, admit of the adoption of a straight line for two and a half miles, touching the end of Mr. Robinson's dock at Sing Sing. Three miles above Sing Sing the survey crosses the Croton River, which has thrown into the bay vast quantities of gravel, forming a hard bottom, nearly bare at low water. A bridge equal, in the aggregate, to 300 feet, has been deemed sufficient to give free passage to the water. The heavy sand cut, through Teller's Point, will furnish the best kind of material for the embankment across the mouth of the Croton. Above the point, north of Crotonville, an irregular and broken country presents itself, and can only be avoided by keeping on the flat-beach as much as possible, occasionally cutting through points and gradually rising twenty-five feet in two miles, in order to take advantage of a remakable valley lying east of the post road and in the rear of Verplanck's Point. Through this hollow the line extends to Peekskill on favorable ground. Two curves are introduced by taking this course, but not extensive, nor of less than 2000 feet radius. At Peekskill Bay the curve is still more favorable, having a radius of 3000 feet, and where the line crosses, it varies from six to eight feet in depth, with a bottom well calculated for a pile structure.

On proceeding northward from the first point above Peekskill, called Royer's Hook, to Anthony's Nose, the survey is nearly in a straight line, and although the side hill above has a formidable appearance, the rock excavations are not extensive, and the road bed can be formed much more cheaply than was anticipated, the projecting points of rock being very narrow, and the intermediate bays having a hard bottom with shoal water, admit of locating the embankments outside of the base of the hill, thereby rendering them entirely secure from all obstructions and danger. At the Nose, which is formed by the spur of the mountain, a thorough cut of rock of moderate extent, will be necessary. Here the bend of the river causes a deflection of the road; but by keeping on the marsh above, where it is proposed to construct the road, by driving piles, the curve round the Nose would be reduced to 3000 feet radius. This level marsh extends two miles above the Nose, and the shore still farther up, admits of light work till opposite Buttermik Falls, where the deep water leaves no alternative but a heavy rock excavation, which, however, does not prevent the continuation of the route in a very direct line. In several places still farther up, there are similar rocky points, which, with one exception, are avoided by passing through the ravines east of them. This is a heavy cutting near Mr. Phillips', but the materials will be required for the embankment across the bay, which has a hard bottom from 6 to 8 feet in depth extending to Constitution Island; where the line passes east of the rocks opposite West Point, on a marsh reaching nearly to the Cove between the island and Cold Spring, and over which it is easy to construct the road bed.

From Cold Spring to Fishkill, there is already a good road along the base of the mountain, and the construction of a Railroad outside of it will be neither be difficult or expensive. The location above the Highlands is continued on the bank of the river, crossing the mouth of Fishkill and the isthmus of Dennings point, in a straight line to Fishkill Landing. From Fishkill a gradual rise, varying from 14 to 16 feet in the mile, is continued till the table land is gained, near the upper falls of the Wappingers Creek, about a mile and a half above the Print Works at Franklinville. From this point for sixty five miles to the northward the face of the country forms a continued and beautiful plain, uniform in its elevation above the river, and admirably adapted for the construction of a Railroad; although in making the course as straight as practicable, slight and gradual depressions are met with. This plain is the site of all the flourishing villages on the eastern bank of the Hudson, through or near which the survey was made.

In Rensselaer County the face of the country is also generally level, though occasionally intersected by ravines of considerable depth, but remarkably narrow. Within four miles of Greenbush the line is parallel to and near the Boston and Albany Railroad, but in consequence of the difference in the gradients, which in one case are 36 feet to the mile, and the other only 17, the road bed will be lower till it crosses the Eastern turnpike at Greenbush, where the rails will be almost on the same level. My survey ended at Bath, 144 86-100 miles from the city of New-York. No definite plan of the northern termination could now, with propriety, be designated. The practicabllity of providing a convenient depot opposite Albany, or of extending the road to Troy, is sufficiently evident.

The annexed tables exhibit a summary of the general results of the survey, including the heights and distances, the grades and curvature, also the amount of excavations, masonry, &c., with the total cost of graduation.

The quantities of earth and rock have been carefully estimated, and 10 per cent. added for superintendence and contingencies, whilst the prices are ample in every instance.—That the comparative cost of different portions of the line may be clearly understood, it has been divided into three parts. The 1st division extends from Harlaem Creek to Peekskill, 30.5 miles.

Clearing and grubbing,		$3,000 00
Excavation and haulage common earth, cubic yards,	1,942,000	323,941 00
do. Rock do.	46,920	46,920 00
do, Loose do.	21,200	12,720 00
Masonry do.	2,700	8,100 00
Superstructure to bridges, lineal feet	450	8,100 00
Fencing,		12,200 00
		$414,981 00

Cost per mile $13,605 92.

2nd Division extends from Peekskill to Rhinebeck 47,38 miles.

Clearing and grubbing,		$5,000 00
Excavation and haulage common earth, cubic yards	2,524,000	501,698 00
do. do. Rock do.	178,930	176,555 00
Masonry, do.	4,174	12,522 00
Superstructure for bridges, lineal ft.	550	9,900 00
Fencing,		34,200 00
		$739,875 00

Cost per mile $15,615 76.

3d Division extends from Rhinebeck to Greenbush, 52,62 miles.

Clearing and grubbing,		$7,000 00
Excavation and haulage common earth, cubic yards,	2,950,000	489,950 00
Masonary for culverts do.	9,096	32,800 00
" for bridges do.	3,672	16,647 00
Superstructure do. lineal feet	450	8,100 00
Fencing,		41,600 00
		$596,097 00

Cost per mile $11,328 33.

Total cost	$1,750,953 00
10 per cent for superintendence and contingencies	175,095 00
	$1,926,048 30

Average cost of grading per mile, $14,758 99.

GRADIENTS.*

Commencing at Harlaem River and terminating at Greenbush, opposite Albany.

52.25 miles level,	
7.	level to 10 feet per mile.
9.	10 " " "
4.	11 " " "
3.	13 " " "
2.	14 " " "
3.	15 " " "
14.5	16 " " "
35.25	17 " " "

Total of Elevations and Depressions.

Ascents 536 feet. Descents 524 feet.
Highest summit 215 feet.

LINEAL ARRANGEMENT.

Extent of curve line from 2000 to 6000 feet radius,	2.50 miles.
" " " " 6000 and over " "	14.00
Total Curvature	16.50
Straight Line	114.00
Total distance,	130,50

In estimating the superstructute, a superior rail similar to the one laid on the Boston and Albany Railroad has been adopted, making a total cost of $6,000 00 per mile.

130.5 miles at $6,000 00 per mile,	$783,000 00
Or $12,000 00 per mile for a double track;	$1,660,000 00

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*NOTE.—Gradients on the New-York and Albany Railroad route.

22.15 miles level,	
26.76 "	level to 10 feet per mile.
26.50 "	10 to 20 " " "
10.09 "	20 to 25 " " "
55.27 "	25 to 30 " " "

Total of Elevations and Depressions.—Ascents 1283 feet. Decents 1245. Highest summit 769 feet.

LINEAL ARRANGEMENT.

Extent of Curve Line from 1200 to 6000 feet Radius,	8.09
" " " " 6000 and over "	30.89
Total curviture,	38,98
Straight line,	101,73
Total distance from Harlaem Bridge,	140.71

Adding the totals for graduation and superstructure, the cost of depots, locomotives, cars, and probable cost of lands, the capital to be invested, will consist of the following items:

Graduation for a double track and fencing,		$1,926,048 00
Superstructure,	"	1,566,000 00
Lands,	"	120,000 00
Engines, cars and depots,		500,000 00
Expense of 6 miles to connect with the Harlaem Railroad		160,554 00
Total amount,		$4,272,602 00

Cost per mile, $31,301 11.

Expenses of a single track.

Graduation and Fencing,	$1,536,000 00
Superstructure,	783,000 00
Lands,	120,000 00
Engines, cars and depots,	400,000 00
Expense of 6 miles to connect with the Harlaem Railroad,	108,843 00
	$2,947,843 00

Cost per mile, $21,595 92.

On comparing these statements with the cost of other Railroads, it should be remembered that the on shores of the Hudson, however rough and formidable they may appear to the eye of an inexperienced observer, the excavation is nearly all side hill work, there being seldom occasion to make what is termed by contractors, thorough cuts. It should also be borne in mind, that a large part of the line is over extensive plains, where the natural surface is remarkably fine.—The price of railroad iron at the present time, including 20 per cent duty, does not exceed $45 per ton. Nearly all the Railroads which have been built in the United States for the last ten years, have been constructed with iron at prices 33 per cent greater, and every description of work at a similarly increased rate; neither was the art of performing the work as well understood.

The whole investment of capital for the construction of the Hudson River Railroad with a double track, would not exceed $4,272,602 00 or $31,306 11 per mile; or, for a single track, $21,595 92. The Utica and Schenectady Railroad cost $18,000 per mile; the adoption of heavy Rails would probably have increased it to $21,000. On the Eastern Railroads the cost per mile has varied from $40,000 to

$52,000 per mile, yielding, notwithstanding dividends on a capital of $13,000,000, an average of 8 per cent.

With respect to the absolute mechanical effects to be realized, the business it will command, and the expense of operating the Hudson River Railroad when finished, I shall endeavor to arrive at correct conclusions by considering their mutual relations, the practical facts upon which the general results may be established, and upon which the success of the undertaking must eventually depend; for besides the first amount to be expended, which is a very essential point to be established, the individual who invests his money would also wish to know how far a well constructed Railroad is capable of competing with the steamboats on the Hudson River; and although the obstructions to navigation by ice for at least three months in the year, would give during that period a decided advantage to the Railroad, its success would be rendered very doubtful unless it could also command a considerable share of the business during the remainder of the season. The value of the stock, therefore, must be mainly dependent upon the superior degree of speed and the rate of fare upon the railroad, compared with these great elements of public patronage on the river.

In propelling steamboats at a high velocity, there is a waste of power, which is fully understood, and the adoption of a certain medium degree of speed is well known as the most economical mode of making the passage. With a locomotive and its train, a similar law holds good, there being a maximum load and a certain degree of velocity to which each particular engine is adapted; and when the speed is increased beyond this point, the load must be diminished in much greater proportion. The theory by which this diminution may be calculated, is fully confirmed by experience. The comparative expense at high degrees of velocity, being susceptible of great reduction by the perfection of superstructure and the superiority of the cars. The best steamboats which run between New-York and Albany, make the passage, on an average, in ten hours; by an extraordinary consumption of fuel (tide and wind in favor,) the distance has been run in an hour and forty minutes less time; which is equal to a velocity of 17 1-2 miles per hour. There is no probability that this degree of speed could be rendered constant by any mechanical improvements whatever; the resistance of so dense a medium as water cannot be overcome to a much greater extent than is now accomplished. The extreme cases with railroads and daily improvements, show on the contrary the certainty of a great advancement in their future powers.

On the Great Western Railroad between London and Bristol, *with gradients of* 4 *feet to the mile*, a locomotive properly constructed and adapted to the object, has been known to drag a load equal to 224 passengers and their baggage, at an average velocity of 40 miles per hour. On the Birmingham and London Railroad, with *gradients of* 16 *feet to the mile*, a train of equal magnitude and weight, has frequently been moved over the road at the rate of 32 miles per hour; and in the United States, engines and their trains often run at a velocity exceeding 30 miles per hour. The average rate of travelling is, however limited, at present to 20 miles per hour, for several practical reasons. 1st. The danger arising from an imperfect track; 2d, the increase of expense; and 3d, the want of competition to stimulate improvement.

To show however what may be accomplished on a more perfect kind of superstructure, I shall refer to the daily performance on the Boston and Albany Railroad. The passenger train containing 200 persons, drawn by a locomotive of 12 tons, weighing in the aggregate with the tender 57 tons, ascends their long grades of 80 feet to the mile, with a velocity of 12 miles per hour; this is equivalent to 297 tons, or 1540 passengers drawn on a level railroad at the same velocity. On an ascent of seventeen feet to the mile, which is the maximum gradient on the Hudson River Railroad, the same engine and train would be equal to 151 tons, and could ascend it at 12 miles per hour with 750 passengers. By diminishing the load to 57 tons or 200 passengers, the following result would be obtained. On the 17 feet gradient ascending the velocity would be 26 miles per hour, and on the descending planes 38, making an average of 32 miles per hour; the whole distance of 144 miles requiring 4 hours and 30 minutes running time; add 30 minutes for stops—*total* 5 *hours between New-York and Albany.*

On the Boston and Albany Railroad, it is ascertained by careful examinations of the items, that the average cost of running the trains (in some cases of double the weight, and requiring more power than the one referred to,) is 62 cents per mile. Considering the heavy gradients, the various contingencies in consequence, also the extra brake men necessary for safety, the same expense per mile, will be an ample allowance for running a train with 200 passengers from New-York to Albany. But it must be observed, that on the Boston as on most other roads, although their engines are capable of drawing the loads referred to, it becomes necessary to provide extra cars, to be ready for any number of travellers who may wish to be conveyed, and therefore carry so much extra dead weight; allowing 38 per cent for this contingency,* and applying it to the Hudson River Railroad, it will be found that the expense of conveying 200 passengers when taken in common with the other business of the road, would be equal to $144, *or 72 cents per passenger.*†

In relation to the second class of cars, where economy and not speed is required, the engine can be worked at its maximum effect, admitting of a load of 570 passengers, with a velocity of 15 miles an hour; and as in this instance the extra dead weight could always be saved by freight, the cost of conveying each passenger from New-York to Albany would not exceed 25 cents per passenger.‡

Having established these data on practical facts, derived from the most authentic sources and corrobrated by my own general experience, as well as by personal observations recently made, expressly in view of this subject, I shall proceed in their application to the particular circumstances affecting the Hudson River Railroad.

The number of passengers who travel in various directions on the Hudson River by steamboats, is estimated from 3000 to 4000 daily. Of these the proportion that would prefer the Railroad, will be composed of four classes; those who value time; those who like to travel fast, whether they have pressing business or not; those who prefer travelling cheaply, and at *least nine-tenths of the way-passengers on the east side* of the river. It must be evident to all who have travelled and are familiar with our national character, that a very large proportion of our population belongs to the two first classes alluded to.

On the Hudson River Railroad, *a train leaving Albany at*

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*This accords exactly with the statement of Chevalier de Gerstner, that $1 per mile is the true cost of an ordinary train.

†On the Liverpool and Manchester Railroad in the first class cars, little more than one-fourth part of the gross weight is composed of passengers and baggage; the average number being three-fifths of a full complement of passengers. On the Boston and Albany Railroad assuming three-fifths as the average number of passengers in the first class cars, it constitutes one-third of the gross weight. To account still further for the difference between the cost per mile as stated by the Chevalier de Gertsner and that of the Liverpool Railroad, it is necessary to take into the account the high charges in the latter case for maintainance of the traffic, which is 1 7-8 cents per ton per mile, which for the transportation of a ton of goods from New-York to Albany would add $2,70 instead of 37½ cents, as on the Boston road—a striking illustration of the advantage of a long line.

‡In relation to second class passengers, whenever they can be transported in large parties, the Boston Company charge but $1 a head, through to Albany, with a line 200 miles long and crossing a summit of 1460 feet.

6 o'clock in the morning, would arrive in the city in time to improve all the business hours; another starting at 9, for the convenience of those who travel for pleasure, would be in either city in good time for dinner. A traveller also leaving New York at 5 A. M., could be in Utica at 3 in the afternoon; and those who should start at 5 P. M., could be in either city at bed time. Travelling in the slow train, the *power* of competition would also secure a large proportion; and in regard to way-passengers, it is only to consider the circumstances in which they are placed in reference to steamboats, to be convinced of the result. *The average of way-fare is 30 per cent above the proportion per mile on the through fare.* At most of the landings more than a hour is spent in waiting, by the majority of the passengers, and in many places in Dutchess and Columbia counties, the distance to the landing is far greater than to the depots on the line of the proposed Railroads—*where the hour and minute for starting would be almost invariable.* And what shows the superior convenience of the Railroad in the most striking point of view, is the fact, that in every village, *including Albany, an individual could leave his residence in the morning, spend from 6 to 9 hours in New-York, and return home by bed time.*

The attractions for those who travel for pleasure (independently of avoiding the tediousness of a whole day on board the steamboat,) may be rendered very great by combining comfort, taste and safety in the cars; for the beauty of scenery on the river is not diminished in any respect, while the country above the Highlands, has a more striking appearance from the railroad, owing to the elevated position of the beholder.

But in estimating the amount of revenue to be derived from the Hudson River Railroad, there are many other sources of business to be considered, arising from its construction through an extensive and fertile district, and to which the river cannot afford equal facilities; the increased productions *thus furnished to the New-York morning market with perfect regularity,* the extent to which these products will be increased by greater facilities, and the inducements which will arise to procure all these luxuries in the highest state of freshness and perfection, must contribute to add to its receipts.

The country on the borders of the river, including only that section of it from which the inhabitants would most conveniently find their way to the city by the river Railroad, contains a population of at least 150,000 persons; and that part of it which lies above the Highlands is no where exceeded in its facilities for business, its productiveness and general influence on the prosperity of New-York.

Besides the receipts, however, to be derived from passengers in the summer season, the amount of the lighter and more valuable kinds of freight which would be transported over the Railroad, becomes a consideration of no less magnitude. Of the traffic with New-York from the district already alluded to, of all kinds of vegetables, of small meats, of milk, butter eggs, &c., a great proportion may be classed with the most profitable kind of freight; the heavier products which could not derive a value from speed and frequency of transit, would generally be freighted on the river. The mechanical fabrics, and the productions of the numerous manufacturing establishments on the line, could not fail of being transported on the Railroad as *source of economy*, and would constitute another large amount of business highly profitable.

Of the exports from the city to supply the wants of 150,000 individuals, a large portion of them, consisting of light and valuable articles, such as dry goods, groceries, cotton, &c., may also be safely estimated as the legitimate business of the Railroad. All these and many other advantages are attainable, simply from the superior facilities which could be provided. But to shew the extent to which this mode of reaching market would meet the convenience of the public and supply the deficiencies on the river, the actual cost of transporting a ton of freight, should be clearly established.

The freight trains on the Boston and Albany Railroad with 60 tons of goods, ascend gradients of 80 feet per mile, and surmount a summit of 1460 feet. The same power when applied on a gradient of 17 feet per mile, would pass over it with 184 tons of goods, and traverse the whole line from Greenbush to New-York, at an expense of $88 40; add to this amount the cost of loading and unloading, delivery, &c., which is equal to 37 1-2 cents per ton, the total cost of 184 tons would be $157 40. We have still, however, to deduct the loss from inequality of business, (and although a train partially loaded would be a more rare occurrence in the valley of the Hudson than on any route in the country,) we will diminish the load 36 per cent, which leaves for the result 118.2 tons of goods, transported at a cost of $118 40, equal to $1 per ton for the whole distance; or less than 8¼ mills per ton per mile. If the sum for profits should be fixed at something more than the actual cost of transportation for goods and passengers pro rata, per mile, the fare for the first class of passengers might be $1,50; of the second 50 cents; and freight per ton $2,50. With these prices it is evident that it would be a losing concern for the steamboats to attempt competition. But allowing that the business should be divided, and that only 300 passengers of each class should pass and repass daily upon the Railroad,—which is about one-third of the present amount of travel—and that the daily freight were only 400 tons, (or about a load for one tow-boat) the annual returns, after deducting the expense of operating, would equal $437,390 00; rather more than 10½ per cent on the whole investment.

To understand that this estimate of returns is very moderate, when compared with the true results, it is only necessary to consider that three-quarters of the freight for which a charge of $2,50 per ton is allowed, is of that description that now pays, on an average, double the amount. Nor have the profits of transporting the mails been included, which will add $30,000 to the annual income. But all these items form scarce a moiety of the trade and travel destined to fall on the Hudson River Railroad.

From the west side of the river in the counties immediately bordering on it, is a population of 138,000 inhabitants, who must depend entirely upon the railroad for the transaction of all their business while the Hudson is closed.

Lines of railroads extending west at various points, must also pour all their business into this main channel. The very arguments most commonly used against this magnificent undertaking, the very fact of its being in the valley of the Hudson, gives it all its value; and to attempt to turn the tide of business from this, its natural course, is, to say the least of it, a great mistake. That the people on the eastern route very anxiously desire the railroad from Albany to New-York should pass through their section of the country, is not surprising; and had not a far superior route been indicated by the hand of nature, it would have been well for New-York to have availed herself of the line which they recommend.

I surveyed most of the route for the New-York and Albany Railroad Company in 1838, and am therefore conversant with the business and capabilities of the whole country comprised between the eastern boundary of New-York and the Hudson River. It was from my labour and report they have principally derived their knowledge of the practicability of their line; consequently no one is better able to judge of the comparative merits of the two lines. I have it in my power to assure you, that you may safely rest the river route upon its own merits. It is a folly New-York cannot be guilty of, to favor the establishment of a Railroad so intimately connected with her future prosperity, without thoroughly investigating the means which may render it effective. The eastern line has long gradients of 30 feet to the mile, and is 5 1-4 miles the longest, unless the Dark Valley route, which is 1 1-2 miles nearer, should be again adopted; but which is so objectionable that the company have rejected it. In operating the lines in question, there would be a difference in favor of the Hudson River R. R. of at least an hour in making the passage with the same load between the two cities. The expense of transportation must be essentially increased, and the power of competition with the river, which is evidently a vital element of success, would be in a great measure lost; because the circumstances which, with the Hudson River Railroad would fix a low rate of fare, must in the other case, be wholly out of reach. The way-passengers on the eastern route would not constitute one-tenth of the number, whilst the steamboats having the landings below Albany to themselves, would put down the through fare accordingly.

The citizens of New-York and capitalists will look at the subject unbiased by local feeling; they will see the absurdity of jeopardizing their own interest for the imaginary advantage of opening as many lines of communication to the interior as possible. The valley of the Oblong on the eastern route, is a fine country; but on the line I have now surveyed, the country within its sphere is equally fertile, three times as extensive, and would yield a far more abundant supply to the New-York markets at quite as cheap a rate. A more enlarged view, however, of the main object of this important work must be taken, as it will be regarded the principal avenue (for such it is destined to be) of the greatest commercial city in the Union, leading to the present extened country which sustains it, and one day to become unrivalled in productiveness and wealth by any other country on the globe. Its location will be permanent, and should an error now be committed, the vast population of the west will for ages be compelled to take a circuitous route unnecessarily over a mountainous ridge, while the enterprise and rivalry of Boston must be rendered the more successful in proportion as these facilities of communication are diminished.

I am, gentlemen,
very respectfully,
your obedient servant,

RICHARD P. MORGAN.

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